IN THE DISTRICT COURT FOR THE UNITED STATES OF AMERICA
WESTERN DISTRICT OF TENNESSEE

SCOTT TURNAGE , CORTEZ D. BROWN, DEONTAE TATE, JEREMY S. MELTON, ISSACCA POWELL, KEITH BURGESS, TRAVIS BOYD, TERRENCE DRAIN, and KIMBERLY ALLEN on behalf of themselves and all similarly situated persons, Plaintiffs, v. BILL OLDHAM, in his individual capacity and in his official capacity as the Sheriff of Shelby County, Tennessee; ROBERT MOORE, in his individual capacity and in his official capacity as the Jail Director of Shelby County, Tennessee; CHARLENE MCGHEE, in her individual capacity and in her official capacity as the Assistant Chief of Jail Security of Shelby County, Tennessee; DEBRA HAMMONS, in her individual capacity and in her official capacity as the Assistant Chief of Jail Programs of Shelby County, Tennessee; SHELBY COUNTY, TENNESSEE, a Tennessee municipality; and TYLER TECHNOLOGIES, INC., a foreign corporation, Defendants.	**Civil Action No. 2:16-cv-02907-SHM-tmp** (Hon. Judge Samuel H. Mays)

NOTICE OF FILING OF REPORT OF MATTHEW S. SHOTWELL, PH.D.

Defendants Shelby County, Bill Oldham, Robert Moore, Charlene McGhee, and Debra

Hammons (collectively, the "Shelby County Defendants"), by and through counsel, hereby file

the attached Report of Matthew S. Shotwell, PhD.

The Shelby County Defendants do not agree with the Plaintiffs' theory that six (6) hours is the threshold for over-detention of arrestees. The Shelby County Defendants are only using this timeframe pursuant to the Court's Orders and to determine the process for selecting "jackets" in this lawsuit.

Respectfully submitted,

/s/ Meghan M. Cox
Robert E. Craddock, Jr. (# 5826)
Odell Horton, Jr. (# 12426)
Byron N. Brown IV (# 23529)
Meghan M. Cox (# 33028)
Wyatt Tarrant & Combs LLP
6070 Poplar Ave., Suite 300
Memphis, TN 38119
(901) 537-1000
rcraddock@wyattfirm.com
ohorton@wyattfirm.com
bbrown@wyattfirm.com
mcox@wyattfirm.com

and

E. Lee Whitwell (# 33622)
Shelby County Attorney's Office
160 North Main Street, Suite 950
Memphis, TN 38103
(901) 222-2100
lee.whitwell@shelbycountytn.gov

Counsel for Shelby County Defendants

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CERTIFICATE OF SERVICE

The undersigned certifies that on January 11, 2018, a true and correct copy of the foregoing has been served upon the following counsel, via the Court's ECF filing system:

Michael G. McLaren
William E. Cochran, Jr.
Brice M. Timmons
BLACK MCLAREN JONES RYLAND &
GRIFFEE PC
530 Oak Court Drive, Suite 360
Memphis, TN 38117

Bradley E. Trammell
Baker, Donelson, Bearman, Caldwell & Berkowitz
165 Madison Avenue, Suite 2000
Memphis, TN 38103

Frank L. Watson, III
William F. Burns
WATSON BURNS, PLLC
253 Adams Avenue
Memphis, Tennessee 38104

Beth Petronio
K&L Gates
1717 Main Street, Suite 2800
Dallas, Texas 7520

/s/ Meghan M. Cox   ____

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IN THE DISTRICT COURT FOR THE UNITED STATES OF AMERICA
WESTERN DISTRICT OF TENNESSEE

)	
SCOTT TURNAGE , CORTEZ D.)	
BROWN, DEONTAE TATE, JEREMY S.)	
MELTON, ISSACCA POWELL, KEITH)	
BURGESS, TRAVIS BOYD, TERRENCE DRAIN,)	**Civil Action No. 2:16-cv-02907-SHM-**
and KIMBERLY ALLEN on)	**tmp**
behalf of themselves and all similarly)	
situated persons,)	
)	(Hon. Judge Samuel H. Mays)
Plaintiffs,)	
)	
v.)	
)	
BILL OLDHAM, in his individual capacity and in)	
his official capacity as the Sheriff of Shelby County,)	
Tennessee; ROBERT MOORE, in his individual)	
capacity and in his official capacity as the Jail)	
Director of Shelby County, Tennessee; CHARLENE)	
MCGHEE, in her individual capacity and in her)	
official capacity as the Assistant Chief of Jail)	
Security of Shelby County, Tennessee; DEBRA)	
HAMMONS, in her individual capacity and in her)	
official capacity as the Assistant Chief of Jail)	
Programs of Shelby County, Tennessee; SHELBY)	
COUNTY, TENNESSEE, a Tennessee municipality;)	
and TYLER TECHNOLOGIES, INC., a foreign)	
corporation,)	
)	
Defendants.)	
)	

REPORT OF MATTHEW S. SHOTWELL, PH.D.

I have reviewed the plaintiffs' affidavit regarding the minimum sample size needed to estimate the proportion of inmates in the Shelby County, Tennessee Jail who were held more than six hours after a court had ordered their release, and who had no holds or detainers, between the dates of November 1, 2016 through May 30, 2017. During this period of time, roughly 15000 inmates were held by the Shelby County Jail (i.e., the 'population').

The sample size formulas presented in the affidavit, specifically formulas 1.0 and 2.0, are standard formulas that rely on the "large sample" behavior of the proportion estimator in a random sample from a finite population. These formulas are used to determine the minimum sample size needed to achieve a specified margin of error (MOE). The minimum sample size also depends on the true (but unknown) proportion of over-detained inmates in this population. Thus, the plaintiffs' affidavit has assumed a proportion that yields the largest MOE for any particular sample size (i.e., 0.5). This ensures that the actual MOE is no larger than the specified MOE. These formulas and this approach are appropriate for the task at hand.

An acceptable value of the MOE is generally determined by the intended use of the proportion estimate, and the potential consequences of an error in estimation due to random sampling. The plaintiffs' affidavit presented two alternative sample sizes (n = 996 or n = 359) to achieve a MOE of either three or five percentage points (0.03 or 0.05, respectively), thus indicating that a MOE of five percentage points is likely acceptable in the current context. In attempting to reproduce the sample size values using formulas 1.0 and 2.0, I found that n = 375 is needed to achieve a MOE of five percentage points, rather than n = 359 as reported in the affidavit.

The plaintiffs' affidavit further demonstrates that, for either alternative sample size (n = 996 or n = 359), the probability that the estimated number of over-detained inmates is less than 100 is small. These calculations are correct and provide further evidence that either sample size is sufficient to evaluate the proportion and total number of over-detained inmates in this population.

The plaintiffs' affidavit does not address sampling methodology. In order to achieve an unbiased estimate of the proportion of inmates that were over-detained in this population, and to ensure that the selected sample size is sufficient to achieve the specified margin of error, a random sample of the population of roughly 15000 inmates that were held in the Shelby County Jail between Nov. 1, 2016 and May 30, 2017 is needed. A sample drawn in an alternative fashion, for example by sampling only among inmates that were held during the first two months beginning Nov. 1, 2016, is not suitable because such a sample may not be representative of the population, and may result in a biased estimate of the proportion of over-detained inmates.

A secondary objective discussed briefly in the plaintiffs' affidavit is to estimate the average number of hours beyond six that inmates were held among those that were over-detained. The plaintiffs' expert argues that, because there is likely to be significant variability in the hours of over-detention, "a sample in the 359 to 996 range is needed." No further details are provided. A more precise evaluation of sample size adequacy for this objective is complicated due to uncertainty regarding the fraction of inmates that were over-detained, and unknown variability in the hours of over-detention. The former is relevant because only a fraction of the sampled inmates - those that were over-detained - provide information. The formula below provides the

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approximate sample size needed to achieve a specified margin of error (MOE) in estimating the average (mean) number of hours of over-detention, and is analogous to formula 1.0 in the plaintiffs' affidavit.

$$n = z_{\alpha/2}^2 \left(\frac{\sigma}{\text{MOE}} \right)^2$$

In the above expression, σ represents the standard deviation of the number of hours beyond six that inmates were held among those that were over-detained. This expression does not include a finite population correction factor, but nevertheless yields a sample size at least as large as the finite population-corrected formula. The approximate value of $z_{\alpha/2}$ is 1.96 for a 95% confidence level. Although σ is unknown, the MOE can be expressed in relative terms, as a percentage of σ. By rearranging this expression, the margin of error (relative to σ) can be computed for a specified sample size as follows:

$$\text{MOE} = \frac{z_{\alpha/2}}{\sqrt{n}} \sigma$$

Assuming that 25% of a sample of 375 inmates are over-detained, about 94 inmate records would be available to estimate the mean number of hours beyond six that over-detained inmates were held. Substituting n = 94 into the above expression, the resulting margin of error is about 0.20σ, or 20% of σ. To provide a specific example, suppose that the standard deviation of the number of hours of over-detention is 24 hours, then the MOE in estimating the average number of hours of over-detention would be about 5 hours. Alternatively, if just 5% of the 375 inmates are over-detained, and the standard deviation is 72 hours, then the MOE would be about 33 hours. Thus, due to the unknown variability in the number of hours of over-detention, and unknown proportion of over-detained inmates, there is substantial uncertainty regarding the margin of error in estimating the mean number of hours of over-detention.

In conclusion, after review of the plaintiffs' affidavit, I found that the methods and formulas used to determine the minimum sample size in estimating the proportion of over-detained inmates were appropriate, and that a worst-case MOE of five percentage points is likely acceptable in this context. Thus, the minimum sample size needed to achieve this objective is n = 375. After additional analysis of the secondary objective - to estimate the mean number of hours that over-detained inmates were held - I found that uncertainty about the prevalence and severity of over-detention precludes a precise assessment of the margin of error. In the event that a sample of size n = 375 does not provide a sufficient precision in estimating the mean hours of over-detention, these data would at least provide for a more informed re-assessment of the sample size needed to address the secondary objective. Finally, for these analyses to be valid, the sample must be selected uniformly at random from the population of roughly 15000 inmates that were held in the Shelby County Jail between Nov. 1, 2016 and May 30, 2017.

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Matthew S. Shotwell

Matthew S. Shotwell

_1/11/2019_

Date